

Short communication

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Pyruvate kinase in human amniotic fluid – a new indicator of fetal maturity in late pregnancy

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In the search for new clinically applicable parameters for the prenatal assessment of fetal maturity, we examined the pyruvate kinase activity in amniotic fluid samples. The enzyme was discovered in the thirties by LOHMANN and MEYERHOF [2, 4]. Pyruvate kinase [PK] (ATP: pyruvate 2-O-phosphotransferase, E.C. 2.7.1.40) transfers the energy-rich phosphate bond of phosphoenolpyruvate to ADP under formation of ATP and pyruvate. As an enzyme of glycolysis PK is chiefly present in the cytoplasm.

We measured PK activity in a reaction coupled with lactate dehydrogenase by the decrease of NADH absorbance per time interval, whereby the converted quantity of phosphoenolpyruvate or pyruvate and the NADH decrease are synchronized [1]. Interfering glycolytic metabolites are eliminated prior to the PK reaction; the reaction commences only after addition of ADP solution. The

determination becomes in this way specific for pyruvate kinase.

Seventy-three amniotic fluid samples were examined (Tab. I); they contained neither meconium nor blood. Amniotic fluid was obtained by transabdominal ultrasound-directed amniocentesis. At term (37–42 weeks of gestation) the fluid was obtained by transcervical amniocentesis at the onset of labor. Since PK *in vitro* is labile, the samples were centrifuged at 2° to 4 °C immediately after withdrawal, and the supernatant was subsequently processed.

During the second trimester and up to the 33rd gestational week, we could only measure slight PK activities in amniotic fluid. In half of the cases no PK activity was detectable at all. From the 34th week to the 36th week of gestation a discrete PK increase was observed; the maximal level recorded was below 7 U/L.

Tab. I. Pyruvate kinase activity in amniotic fluid. 90 % C.L. = 90 % confidence limits, range between 5th and 95th percentiles.

Weeks of gestation	No. of samples assayed	Pyruvate kinase activity (U/L)			
		Mean	Median	90 % C.L.	Min. – Max.
15–19	20	0.3	0.1	0.01– 1.0	0– 1.9
24–33	5	1.1	0.8	0.2 – 2.3	0– 2.1
34–36	12	2.3	1.9	1.0 – 5.9	1– 6.4
37–42	36	26.9	15.5	4.0 –85.2	3–131

At term (37 to 42 weeks) a very steep rise in amniotic fluid pyruvate kinase could be noticed; only a small proportion of values (6 out of 36) lay below 7 U/L. There was a significant positive correlation between PK values and amniocrit values ($p < 0.05$; $r = 0.35$, $\nu = 34$). (The amniocrit represents the proportion of cellular constituents in amniotic fluid (v/v), expressed as percentage.)

No PK activity was found in 20 meconium-stained amniotic fluid samples. Addition of meconium to amniotic fluid samples with previously present PK activity led to a disappearance of the enzyme activity.

The first postnatal urine from newborns contained no PK or only a trace of the enzyme. The pyruvate kinase activity in amniotic fluid and that in the

plasma of umbilical venous blood of the same neonates did not correlate.

Supplementary studies on the origin of the enzyme in amniotic fluid produced in essence the following results. By means of artificial in vitro cytolysis in amniotic fluid sediments, additional PK activity could be liberated. Considerable PK activity was detectable in tracheal secretions of therapeutically intubated newborn infants. Thus, the presumable main sources of the enzyme in amniotic fluid are the epithelium cells of the skin, the respiratory tract and the amnion [3].

According to the results of this pilot study and particularly in view of the rapid PK rise "at term", assay of amniotic fluid pyruvate kinase appears to be of clinical importance as an additional indicator of fetal maturity in the perinatal period.

Summary

During the second and third trimesters increasing activities of the glycolytic enzyme pyruvate kinase are to be found in human amniotic fluid. At term (37 to 42 weeks), a very steep rise in amniotic fluid pyruvate kinase can be noticed, which may serve as an additional prenatal indicator of fetal maturity.

Keywords: Amniotic fluid, fetal maturity, pyruvate kinase.

Zusammenfassung

Pyruvat-Kinase in menschlichem Fruchtwasser — ein neuer Indikator der Fetalreife in der Spätschwangerschaft
In menschlichem Fruchtwasser aus dem zweiten und dritten Trimenon sind steigende Aktivitäten des Glykolyse-Enzyms Pyruvat-Kinase nachzuweisen. Am Termin (SSW 37 bis 42) ist ein sehr steiler Anstieg der Pyruvat-Kinase-Aktivität zu beobachten, der als zusätzlicher pränataler Indikator des fetalen Reifungsgrades dienen kann.

Schlüsselwörter: Fetalreife, Fruchtwasser, Pyruvat-Kinase.

Résumé

La pyruvate kinase dans le liquide amniotique humain: Un nouvel indicateur de la maturité fœtale en fin de grossesse.

On a trouvé une augmentation de l'activité de la pyruvate kinase, enzyme de la glycolyse, dans le liquide amniotique humain au cours du 2ème et du 3ème trimestre. A terme (37 à 42 semaines) on peut remarquer une élévation très notable de la pyruvate kinase amniotique, qui peut servir

Mots-clés: Liquide amniotique, maturité fœtale, pyruvate kinase.

The presumable main sources of the enzyme in amniotic fluid are the epithelium cells of the skin, the respiratory tract and the amnion. In meconium stained amniotic fluid no pyruvate kinase activity is detectable. Addition of meconium to amniotic fluid samples with previously present pyruvate kinase activity leads to a disappearance of the enzyme activity.

Die vermutlichen Hauptquellen des Enzyms im Fruchtwasser sind die Epithelzellen der Haut, der Luftwege und des Amnions.

In mekoniumhaltigen Fruchtwasser-Proben ist keine Pyruvat-Kinase-Aktivität nachweisbar. Zusatz von Mekonium zu Fruchtwasser mit vorher vorhandener Pyruvat-Kinase-Aktivität führt zum Verschwinden der Enzym-Aktivität.

comme indicateur prénatal supplémentaire de la maturité fœtale.

Les cellules épithéliales cutanées, l'arbre respiratoire et l'amnios sont les sources principales supposées de l'enzyme du liquide amniotique. On ne peut détecter d'activité pyruvate kinase dans les liquides méconiaux. L'addition de méconium à des liquides possédant auparavant une activité pyruvate kinase entraîne la disparition de l'activité enzymatique.

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